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THE VETERINARY JOURNAL

A MONTHLY REVIEW OF VETERINARY SCIENCE

Est. 1875

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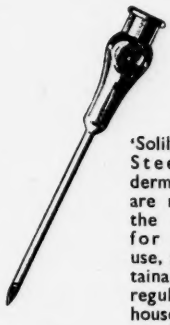

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The Veterinary Journal

JULY, 1947

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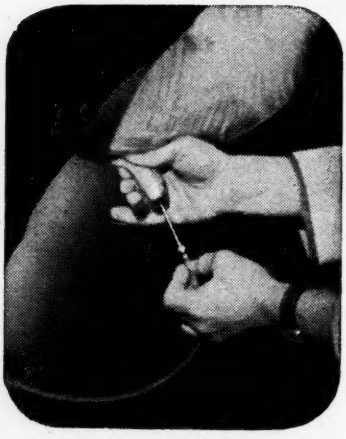

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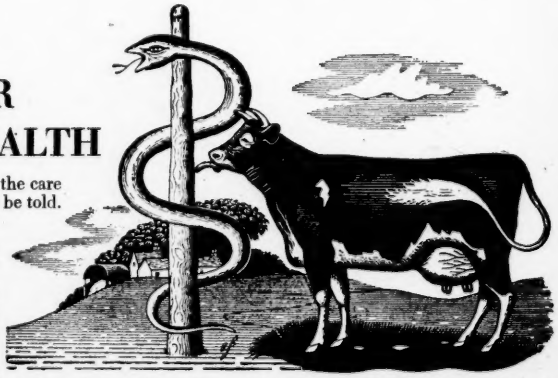

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THE VETERINARY JOURNAL

EDITORS: T. DALLING, *M.A., M.R.C.V.S.* J. McCUNN, *M.R.C.V.S., L.R.C.P.*

Vol. 103 July, 1947 No. 7

EDITORIAL

VETERINARY CONGRESSES

We reproduce in this issue of the Veterinary Journal the programme of the Congress of the National Veterinary Medical Association to be held in Edinburgh from July 27 to August 1. The holding of the Annual Congress in Edinburgh is indicative of a return to normal conditions. During some of the war and post-war years the Association gallantly arranged Congresses, sometimes on a much-reduced scale, in London; although they served their purpose and were highly successful gatherings, the return of the Annual Congress to parts of the country outside London is a sure sign that we have left the war years behind us and are again resuming our former procedures. It is a happy choice of the organisers to select Edinburgh as the first city outside London for the holding of this Congress, for with Edinburgh we associate the names of famous men and women who have done so much for the progress of veterinary science and medicine and have left their mark in the Veterinary Profession. To many, the attendance at the Congress in the Royal (Dick) Veterinary College will recall other days when they received their early introduction to and education in veterinary medicine; to others, the visit will mean an opportunity of seeing an institution from which many great men have gone forth.

The value attached to the holding of Congresses has sometimes been questioned. Those of us who have attended Congresses, not only in veterinary science but in many other subjects, can have no doubt of the importance of and the benefits to be derived from such gatherings where men and women interested in the subject meet to discuss the numerous problems which present themselves. The wise choice of subjects for discussion with suitable writers of the papers presented and openers of discussion of the papers paves the way for the presentation of much useful information and allows opportunities for those experienced in the subject to tell of their views and findings. Much useful information is gathered together by this means and its subsequent publication gives to the scientific world some of the latest observations on many subjects. Apart from the set subjects for discussion, however, those attending a Congress find benefit from those little "corner" talks which are seen to take place all the time. Everyone has his own problems in his daily professional life; he can discuss them with his professional

colleagues and can give as well as receive information helpful to all concerned. Sometimes these talks are of as much importance to some of us as are the set discussions. At Congresses also it is the custom for producers of medicaments and equipment to exhibit their products; new materials and new apparatus are shown and the Profession has thus an opportunity of becoming acquainted with some of the most recently devised products found useful in the fields of medicine and surgery. Text-books also are on show and the busy practitioner may, at a Congress, see for the first time some valuable work of which he may not have already heard and which he may find useful to add to his library.

The social side of a Congress must not be forgotten. The meeting of old friends, and this often only occurs at such gatherings, is one of the highlights, for the busy man or woman finds time on these occasions to sit down for a spell and meet the friends who may live in distant parts.

Congresses are well worth while. We wish the Edinburgh Congress every success and look forward to the publication of its proceedings with much interest.

CONTROL OF BOVINE TUBERCULOSIS

In this issue of the Veterinary Journal we publish with much pleasure an article by F. Wöldike Nielsen, Chief Veterinary Inspector, the Veterinary Directorate, Copenhagen, on the "Combating of Tuberculosis among Cattle in Denmark." We draw our readers' attention to this article for in it will be found an account of the progress that has been made in recent years until, in 1946, 93.9 per cent. of the herds throughout Denmark were found to contain no reactors to the tuberculin test. This is indeed a satisfactory position and speaks highly for the organisation and methods used in dealing with bovine tuberculosis. It will be observed that a new Act was introduced in 1942 and that, although encouragement is given to rid herds and areas of tuberculosis, certain penalties are also imposed on those in whose herds the disease is still found. Apart from such conditions as restrictions of movements of animals, there is also the reduction in the price paid for the milk produced by herds in which reactors to the tuberculin test are present.

It is also of much interest to note that, now that tuberculosis is well under control, attention is being given to the control of other diseases, e.g., brucellosis. The last sentence in the article is of much significance. The author says: "So, even now it is evident that within a few years, when the last remnants of bovine tuberculosis has been eradicated, Danish agriculture will be ardently engaged in combating the other widespread chronic infectious diseases among the cattle." We look forward with interest to further reports of the efforts of the Veterinary Directorate in Denmark to free their country from the various diseases which have such a bearing on the production of livestock and their products.

EDINBURGH CONGRESS, 1947

THE following is the programme of the Congress to be held at the Royal (Dick) Veterinary College, Summerhall Square, Edinburgh, 9, from July 27 to August 1 (inclusive). It will also serve as a guide to the many social occasions.

SUNDAY, JULY 27

7.30 p.m. to 9.30 p.m. Reception by Scottish Metropolitan Division in Royal (Dick) Veterinary College.

MONDAY, JULY 28

10.30 a.m. ... ... Opening of Congress by the Lord Provost of Edinburgh's Deputy, Bailie Bruce Turnbull.

11 a.m. ... ... Opening of Exhibition of Drugs, Surgical Instruments, Books, etc., by President, N.V.M.A.

11.30 a.m. ... ... Council meeting.

2 p.m. ... ... Paper: "Toxicological Problems in Veterinary Practice," by G. F. Boddie, B.Sc., M.R.C.V.S., F.R.S.E. Openers of discussion: H. H. Green, D.Sc., and T. M. Michtell, M.R.C.V.S., D.V.S.M. Chairman: J. N. Ritchie, B.Sc., M.R.C.V.S., D.V.S.M. Recording Secretary: J. S. S. Inglis, B.Sc., M.R.C.V.S.

2 p.m. ... ... Ladies' outing to Zoological Gardens.

8 p.m. to 1 a.m. ... President's reception and dance (Freemasons' Hall, 96, George Street, Edinburgh, 2).

TUESDAY, JULY 29

9.30 a.m. ... ... Paper: "Retention of the Placenta in the Bovine," by A. J. Kennedy, B.Sc., M.R.C.V.S. Openers of discussion: A. S. Chapman, M.R.C.V.S., and J. M. Rorrison, M.R.C.V.S. Chairman: R. W. Johnston, M.R.C.V.S. Recording Secretary: A. Thomson, M.R.C.V.S.

11 a.m. ... ... V.V.B.F. Ladies' Guild annual general meeting.

2 p.m. ... ... Visit to Laboratories of the Animal Diseases Research Association, Moredun Institute, Gilmerton, or to Corporation Markets and Slaughterhouse, Gorgie, Edinburgh.

7.30 p.m. ... ... Civic reception by the Corporation of the City of Edinburgh. (City Chambers, High Street, Edinburgh.)

WEDNESDAY, JULY 30

9.30 a.m. ... ... Paper: "The Immunology and Epidemiology of Virus Diseases," by M. Crawford, M.R.C.V.S. Openers of discussion: I. A. Galloway, D.Sc., M.R.C.V.S., and D. R. Wilson, D.Sc., M.R.C.V.S., D.V.S.M., F.R.S.E. Chairman: D. C. Matheson, M.R.C.V.S., D.V.S.M., F.R.S.E. Recording Secretary: J. W. Emslie, B.Sc., M.R.C.V.S.

WEDNESDAY, JULY 30—*continued*

10 a.m.	Ladies' golf tournament at Liberton Golf Course.
1.45 p.m.	Congress photograph.
2.30 p.m.	Ladies' outing to Lauriston Castle.
2.30 p.m.	Annual general meeting.
7.30 p.m. for 8 p.m. ...	Annual dinner in Freemasons' Hall.

THURSDAY, JULY 31

9.30 a.m.	All-day excursion to Trossachs.
10 a.m.	All-day excursion to Borders.
10 a.m.	Men's golf tournament at Luffness Golf Course.
8.30 p.m. to 1 a.m. ...	Ladies' Veterinary Benevolent Guild dance.

FRIDAY, AUGUST 1

10 a.m.	Closing meeting.
11 a.m.	Council meeting.
2 p.m.	Conducted tour of Royal Mile, Edinburgh.

GENERAL ARTICLES

EMBRYONAL NEPHROMA IN THE DOMESTIC FOWL

By N. H. HOLE and L. M. MARKSON

Section of Pathological Anatomy, Veterinary Laboratory, New Haw, Weybridge

AN embryonal nephroma is a mixed neoplasm to which many names—e.g., adenosarcoma, carcino-sarcoma, nephroblastoma—have been given in the attempt adequately to describe its structure. It is now generally accepted that Wilms' tumour of children belongs to the same group. Feldman (1932) devotes a chapter to the subject in his monograph on animal neoplasms, and classifies 9.6 per cent. of the neoplasms he examined as embryonal nephromata. The incidence was highest in swine and lowest in cattle, and he found five such neoplasms among the fifty-five he examined in poultry. Mathews (1929) describes twelve in fowls, with a periosteal attachment dorsal to the kidney and separated from it by a fibrous capsule (though it is clear from his description that they were neoplasms of the kidney). Three out of Feldman's forty-six cases in swine were entirely separate from the kidney. Day (1907) observed forty-seven in swine, Polson (1927) seven in rabbits. Other references in the literature include: Barlow (1938), who discusses one case in the horse both clinically and *post mortem;* Weitz and McClelland (1940), who observed only one case in the dog; Hamilton (1936), who in three thousand poultry autopsies saw only one embryonal nephroma—in a Light Sussex pullet; Campbell's (1942) case in an eighteen-months White Leghorn hen, a typical growth in the right kidney with what he thought might be an early stage of development of the same type of neoplasm in the left; Walker (1943), who recorded an embryonal nephroma in a three-months-old calf, which he considered to be extra-renal; Kinsley (1930), who described a clinical case in a very young gilt; and McKenney (1931), who recorded two cases in poultry situated within the kidney. Further references may be found in the book on "Diseases of Poultry," edited by Biester and Devries (1944).

Primary extra-renal occurrence of this neoplasm would seem to be rare, although metastases may occur in lymph nodes and even in the lung (Feldman). Mathews records that ten of his twelve cases were in fowls of the Barred Rock breed, but genetic influence is open to question.

The genesis of embryonal nephroma has been discussed by Wilms (1899) and by Wollstein (1927). The neoplasm presumably arises from aberrant embryonal cells in the prenatal kidney, probably from one type of cell, but probably at different stages of its development; this accounts for the great structural variety within a single neoplasm. The occurrence of such growths separate from the kidney can be accounted for by their histogenesis from fœtal "cell-rests"—possibly derived from the Wolffian Body—which, having escaped normal inclusion in the renal gland, have persisted into postnatal life, developing as autonomous, extra-renal neoplasms.

In a short series of three hundred and twelve fowl tumours sent to us for examination, we diagnosed five as embryonal nephromata, three of which presented unusual features.

Case 1.—Rhode Island Red. The post mortem report we received stated that a large fibrous-looking growth about the size of a cricket ball, with multiple cystic areas, was attached by a stalk to the left ovary. The cystic areas contained a large amount of clear fluid. Liver and kidneys were normal and the remainder of the ovary degenerate. We received portions of liver, kidney and tumour for examination. Sections of the liver and kidney portions showed their normal histological structure, but the tumour had the appearance of an embryonal nephroma: the acinous structures, the tubules in transverse section, the abundant collagen fibrous stroma, the cystic spaces lined by epithelium with papilliform ingrowths and the quasi-glomerular structures, were all typical. The connective tissue was quite well differentiated into fibroblasts and abundant collagen fibres (van Gieson's stain). Also present were a number of hyalin-like structures, strongly eosinophilic in staining reaction, concentrically laminated and encompassed by a single layer of low epithelium. We think these are similar to the structures illustrated by Mathews and called by him kerato-hyalin.

Case 2.—Rhode Island Red. "Large encapsulated growth, very tough to cut . . . involving nine-tenths of the left kidney, filling the whole of the left abdomen; cystic in part." Microscopically, some of the tubules were well differentiated, while the neoplasm as a whole was rather sarcomatous. The right kidney was apparently normal.

Case 3.—Rhode Island Red. "Small cystic tumour in the anterior pole of the left kidney. Fowl paralysis." Histological examination showed many small cystic spaces, while the stroma was mostly collagenous fibrous tissue with some small areas of sarcomatous activity.

Case 4.—Rhode Island Red. "Middle third of left kidney contained a large, white, fibrous, cystic tumour . . . the size of a hen's egg." Microscopically, there was a fair balance between sarcomatous and carcinomatous elements. There were several of Mathews' "kerato-hyalin" structures in the section. There was, too, a concurrent lymphocytoma affecting the liver, pancreas, mesentery, intestines and right kidney, but not the already affected left kidney.

Case 5.—Light Sussex. "Ovary—large, pinkish-white, fibrous tumour the size of a tennis ball and cystic in parts." Of the five neoplasms this one had most nearly succeeded in imitating renal tissue; there were many well-formed tubules and even glomeruli had been closely simulated. A feature possessed by none of the others was the presence of several well-defined bands of unstriped muscle fibres—though in our experience unstriped muscle is frequently found in the galline ovary.

Another case of embryonal nephroma, dealt with separately because it does not belong to the series of tumours previously mentioned, has been brought to our notice. *Subject*: A Rhode Island Red seen *post mortem*. A large tumour, weighing 201 gms. and measuring 11 cms. long by 8.5 cms. broad, filled the abdominal cavity with a membranous attachment to the right sublumbar region, there being no anterior pole to the right kidney. The surface of the tumour was bosselated, the cut surface lobulated. The tumour was well defined, encapsulated and tough to cut, and only one small cyst was seen on slicing.

Discussion

It is now generally accepted that embryonal nephromata are quite common neoplasms in the Pig and not uncommon in the domestic Fowl, but most of the references to its occurrence in the latter species have recorded involvement of only the left kidney. Five embryonal nephromata are here recorded in a series of three hundred and twelve tumours found in poultry; of these, three were situated in the left kidney, one in the ovary and one attached by a stalk to the ovary. Judging by the literature, extra-renal occurrence of this neoplasm is uncommon and in the ovary quite rare. Why this should be we do not know, but such an unusual site is not inexplicable in view of the close histogenetical connection between the sexual and the urinary organs. Of the three neoplasms occurring in the left kidney, one was associated with a widespread lymphocytoma. This too would seem to be a not inexplicable coincidence, though its rarity merits its being recorded here. The left kidney is the one most commonly affected by embryonal nephromata, but the sixth case we record seems to have originated in the right kidney. Of these six neoplasms, five occurred in the Rhode Island Red, but as this breed forms a large proportion of the carcases handled by our Poultry Diagnosis Department, the significance of that fact is questionable.

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ALL SECTIONS STAINED BY HÆMATOXYLIN AND EOSIN.

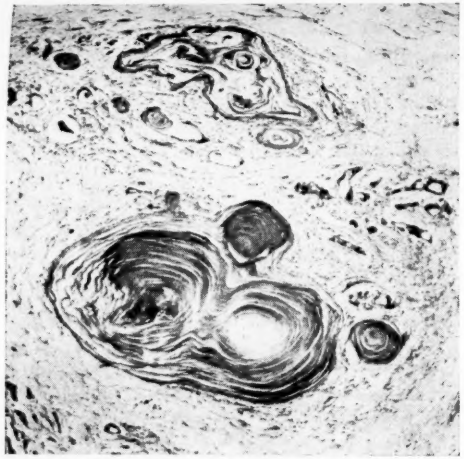

PLATE I
Case 1: Keratohyalin structures (x 50).

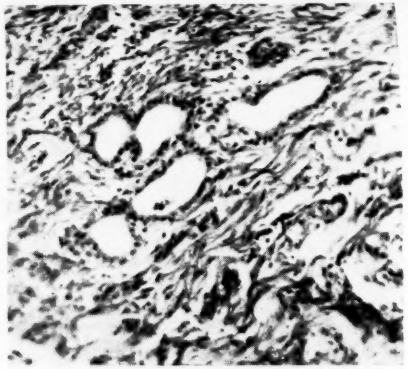

PLATE II
Case 2: Well-formed tubules (x 225).

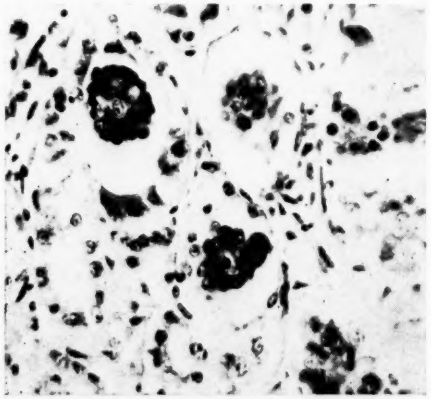

PLATE III
Case 5: Glomerulus formation and tubules (x 575).

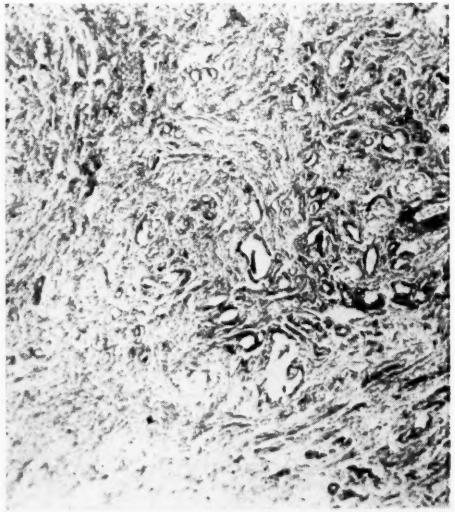

PLATE IV
Case 2: General structure (x 50).

ALL SECTIONS STAINED BY HÆMATOXYLIN AND EOSIN.

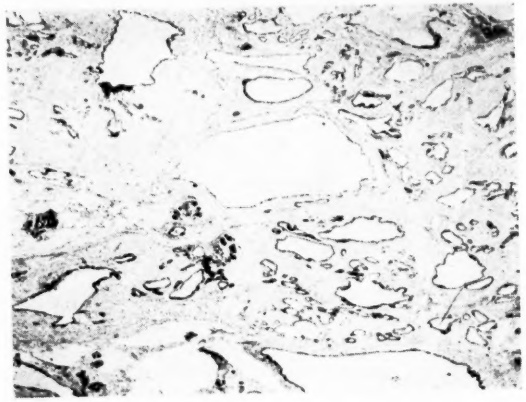

PLATE V

Case 3: General structure—cystic nature well shown (x 30).

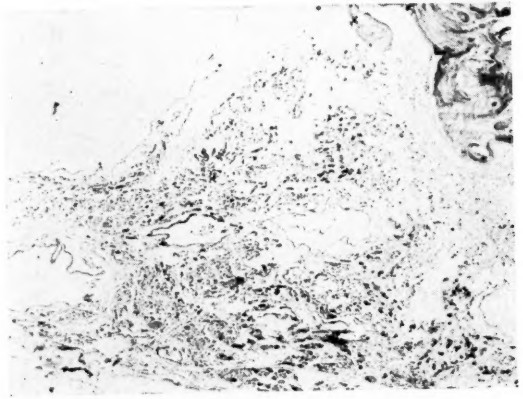

PLATE VI

Case 4: General structure, keratohyalin top right-hand corner, large cystic space top left (x 30).

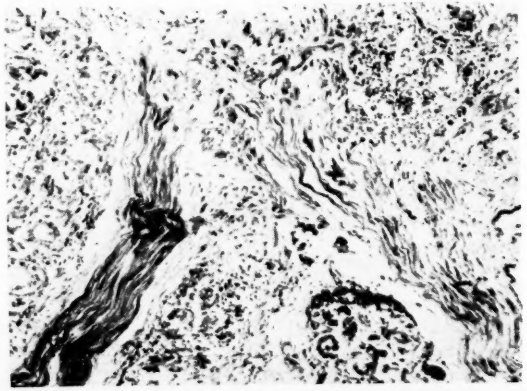

PLATE VII

Case 5: General structure including two broad bands of unstriped muscle fibres (x 75).

THE USE OF STILBŒSTROL DIPROPIONATE IN THE TREATMENT OF RETAINED PLACENTA AND PYOMETRA IN CATTLE

By R. W. L. CHESNEY, M.R.C.V.S.
Williton, Somerset

IT is generally accepted that stilbœstrol is not a specific treatment for the removal of retained placentæ.

Moore (1946) used doses ranging from 30-80 mgm. and considered the drug unsuitable for use in cases of retained placenta. He used single and repeated doses on 43 cows and found that four expelled the placenta, nine may have benefited, 25 received no benefit and five suffered injurious effects.

During the past five years I have used this drug on every cow suffering from this condition. The dose employed was 10 mgm. for Channel Island breeds and 20 mgm. i/m for larger breeds. If an animal had not expelled the placenta within 36 hours the first injection was given and in about 60 per cent. of cases the placenta was voided in from 12 to 36 hours, and no pyometra followed. The afterbirth in these cases was much healthier-looking than those removed by hand and there was an infiltration with healthy serous exudate with an absence of any putrifactive odour. In a number of cases where the placenta was still retained following injection it was found to be lying on the floor of the vagina, quite separate from the uterus. If the injection is given later than 96 hours after calving, the placenta may be expelled within a day or two, or be retained indefinitely unless another injection is given about three days after the first, and then the placenta may come away within 24 hours or be retained and decompose, and the cow will discharge a reddish-yellow discharge for some days, but this discharge will not be offensive in odour and seldom becomes chronic. I have treated approximately 200 cows with stilbœstrol and, apart from about 20 which did not respond and from which I had to remove the placenta manually, the percentage of subsequent pyometras was very small. I have never had reason to suspect the drug of causing permanent or fatal trouble and this may be due to the strength of the injections used. I am convinced that stilbœstrol, if not a specific, is a very suitable drug for use in this condition as there is no doubt in my mind that it has a direct action on the uterus and its contents, being a stimulant to the organ and a great aid to the expulsion of the placenta in its entirety, thus reducing to a minimum the possibility of subsequent pyometra.

Moore (1946) considers pyometra to be a direct result of the manual removal of a retained cleansing. In his experiments he used 43 cows from which the placentæ had been removed manually and which had developed pyometra. Forty-two came on heat following one or two injections of 30-50 mgm. stilbœstrol, and began discharging pus. In two to seven days from onset of œstrus all the uteri were empty and regaining tone, and the 42 cows conceived in from 60-140 days following parturition—this averaged 86.2 days compared with 144.8 days' average in 50 untreated controls.

Since reading Moore's article I have treated thirty pyometra cases with stilbœstrol, two injections of 30 mgm., instead of with iodine irrigation, and, with the

PLATE VII
Case 5: General structure, including two broad bands of unstriped muscle fibres (×75).

exception of two cows which needed a third injection, the uteri all felt normal within a month and conception occurred, in nearly all cases, at the ninth week from calving.

REFERENCE

Moore, G. R. (1946): *J. Amer. Vet. Med. Ass.*, 108, 79-83, 153-156.

HÆMATOLOGY OF HEALTHY KITTENS

By A. R. JENNINGS

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In the past the hæmatology of the cat has received but little attention. The figures, in many cases incomplete, given by various authors have shown wide variations and no definite standards are available. It was thought that a series of blood examinations of normal, healthy cats of approximately known age and known sex would be of value—in fact, it was essential to have some such standards in order to detect deviations from the normal.

Burnett (1917) gave the following summary of findings by different investigators:

Red Corpuscles millions per c.mm.	Leucocytes per c.mm.	Hæmoglobin per cent.	Specific Gravity	Size of Red Corpuscles	Author
6.6	13,331	—	—	—	Busch and Van Bergen
7.28–8.6	18,000	65–80	—	—	Goodall
—	13,500	—	—	—	Goodall, Gulland and Paton
—	—	—	—	5.76μ	Gulliver
9.9	7,200	—	—	6.2μ	Hayem
—	—	—	—	5.77μ	Manassein
7.9	14,000	6.0	—	5.49μ	Mikrukow
6.8	14,017	45.5	1052.6	—	Sherrington
—	—	—	1054	6.5μ	Sussdorf
—	—	—	—	6.5μ	Welcker

Craige, A. H., in Kolmer and Boerner (1941) gave the following figures:

Red blood corpuscles, 7-10 millions per c.mm.
White blood corpuscles, 5-40 thousands per c.mm.
Hæmoglobin, 8-13.8 g. per 100 c.c.
Neutrophils, 3,000-24,700.
Lymphocytes, 1,200-15,000.
Monocytes, 50-5,700.
Eosinophils, 100-3,800.
Basophils, 0-100.

Gaiger and Davies (1946) gave "figures compiled from the findings of numerous investigators":

Red blood corpuscles, 7.5 millions per c.mm.
White blood corpuscles, 14,000 per c.mm.
Neutrophils, 55.15 per cent.
Lymphocytes, 34.5 per cent.
Basophils, 0.35 per cent.
Eosinophils, 5.0 per cent.
Monocytes, 5.0 per cent.

Wintrobe (1946), after Landsbergh, gave figures as follows:

White blood corpuscles, 17.2 ± 6.6 thousands per c.mm.
Red blood corpuscles, 7.2 ± 1.0 millions per c.mm.
Hæmoglobin, 10.5 ± 2.1 g. per 100 ml.
Neutrophils, 59.3 per cent.
Lymphocytes, 33 per cent.
Monocytes, 1 per cent.
Eosinophils, 6.9 per cent.
Basophils, 0 per cent.
Corpuscular volume percentage, 40 ± 6.1.
M.C.V., 57 ± 6.0.
M.C.H.C., 27 ± 4.1.

From the figures given above wide variations will be noted and there are no references as to the age or sex of the cats.

In the present investigation young cats between the ages of one and six months were used. The majority of the cats were female. Only cats which had been healthy a week prior to the removal of the blood and which remained healthy for the succeeding ten days were included in these figures. Venous blood was used throughout, and this was obtained from the cephalic vein. The hair over the vein was clipped, the area swabbed with spirit and the blood withdrawn into a 2.0 ml. syringe which had had a solution of 2.5 per cent. sodium citrate drawn through it. The cats were restrained as in the manner described by Wright (1941) for giving intravenous inoculations. In many cases the examinations were made immediately after obtaining the sample, but where there was likely to be delay the blood was placed in small tubes containing potassium oxalate. This was used in a strength of 3 mg. per ml. In all cases the examinations were carried out within 24 hours after taking the sample.

Red Blood Corpuscles

Red cell counts were made in the usual manner, using normal saline as a diluent. A Thoma counting chamber and pipette were used. Two counts were made on each sample and the mean taken. The number of erythrocytes in millions per c.mm. will be seen in Table I. The mean figure obtained was 6.9 ± 1.0 millions per c.mm.

Hæmoglobin Estimations

The hæmoglobin content was measured by means of a Sahli's hæmoglobinometer. The inadequacy of this method was fully realised, but as this is the

instrument most commonly used in clinical work it was used in these determinations. The same hæmoglobinometer and technique were used throughout. After the addition and mixing of the blood with the acid the tube was allowed to stand at room temperature for ten minutes. The colour matching was then carried out against diffuse daylight. The readings will be found alongside the red count in Table I. The mean value of the hæmoglobin, which was expressed as grams per 100 ml. blood, was 10.9 ± 0.9.

Packed Cell Volume

The packed cell volume, in ten cases, was determined by the use of Wintrobe's hæmatocrit tubes. The tubes were filled to the 5 mark and then centrifuged at 2,000 r.p.m. for 30 minutes. The height of packed cells was then taken and a second spinning of 15 minutes duration at the same speed was given. If there was any variation in the readings a third or fourth centrifuging was done until a constant figure was obtained. Thirty minutes, however, was the usual time required. The packed cell volume was then expressed as a percentage. The mean result was 32.6 ± 3.2.

Fragility Tests

A series of hypotonic saline solutions varying from 0.5 per cent. sodium chloride to 0.28 per cent. sodium chloride was prepared according to the method of Kolmer and Boerner (1942), and 2.0 ml. of each solution placed in a series of small tubes. Into each tube was placed one drop of oxalated venous blood. The tubes were inverted several times and the contents well mixed; they were then left at room temperature for two hours and the readings were taken. The tube in which hæmolysis was beginning and the tube which showed complete hæmolysis were noted. Hæmolysis was complete below 0.36 per cent. and partial at 0.4 per cent.

Reticulocytes

A few reticulocyte counts were made. Slides were covered with a solution of brilliant cresyl blue as in the manner of making a blood film. The dye was allowed to dry, then a drop of fresh blood was placed on the slide and a cover glass dropped on. After 15 minutes the cover glass was drawn along the slide and the resulting blood smear was dried quickly in the air. The film was then counterstained with Leishman. The number of red cells showing reticulum in 500 cells was counted and the result expressed as a percentage. Reticulocytes were very scanty and numbered approximately 0.15 per cent. of the red cells.

Diameter of the Red Cells

Thin blood smears were prepared and stained with Leishman. A micrometer eyepiece, previously calibrated, was used and the diameter of the erythrocytes measured using the 1/12 objective. The diameter of 500 cells was noted. The average diameter was found to be 6.0μ ± 0.3μ.

Mean Corpuscular Volume

The average size of the individual erythrocytes was calculated from the formula:

$$\frac{\text{Volume of packed cells per 1,000 c.c. blood}}{\text{Erythrocytes in millions per c.mm.}}$$

The mean values of the red cells and the packed cell volume were used, and the result was 47.2 cubic microns.

The Specific Gravity of the Blood

This was determined as follows. A urinometer was filled with a mixture of benzene and chloroform so that the specific gravity of the mixture was 1060. Two drops of blood were then placed in the mixture from a pipette, benzene and/or chloroform were then added to the mixture until the drop of blood remained stationary. The specific gravity of the mixture was then taken with a hydrometer. The average result was 1054.

Coagulation Time

Several long fine capillary tubes were prepared and blood was allowed to flow into them by capillary attraction. After three minutes, small lengths of the tubing were broken off at half-minute intervals until such time as the two ends were held together by strands of fibrin. The whole procedure was carried out at room temperature. The time taken from the filling of the tube to the appearance of the fibrin threads was the coagulation time. It varied from two to four minutes.

TABLE I

No.	Red Cell Count in millions per c.mm.	Hæmoglobin in grams per 100 ml.	Total White Cells in thousands per c.mm.
1	6.1	10.2	9.1
2	5.9	11.0	10.0
3	7.5	10.2	12.0
4	5.9	9.5	9.8
5	7.0	10.3	14.0
6	6.0	10.5	9.4
7	6.6	10.2	16.0
8	5.7	10.6	12.0
9	8.6	11.0	9.8
10	5.8	10.4	10.4
11	7.4	9.4	10.5
12	7.3	11.2	10.0
13	7.5	10.2	11.0
14	6.0	10.6	12.0
15	7.2	11.0	12.0
16	6.5	10.2	14.0
17	6.4	12.8	17.2
18	7.2	12.0	16.0
19	6.2	11.0	18.0
20	8.0	12.0	17.0
21	7.2	11.8	12.0
22	7.0	12.0	14.4
23	8.8	12.0	12.0
24	9.0	12.0	15.0
25	6.0	9.5	22.0
	Mean 6.9 ± 1.0	Mean 10.9 ± 0.9	Mean 13.0 ± 3.2

The White Cells

A *total white cell* count was carried out using a Thoma pipette and hæmocytometer. As a diluent Turk's solution was used; it was made up as follows:

Glacial acetic acid, 1 ml.
One per cent. aqueous gentian violet, 1 ml.
Water, 100 ml.

The stock solution was filtered regularly and was replaced several times. Each count was duplicated and the mean taken. The figures for the counts will be seen in Table I. The mean result for the total white cell was 13.0 ± 3.2 thousands per c.mm.

Differential Leucocytic Count

Blood smears were made from the blood of each case and the films stained by Leishman and examined under the oil immersion lens. The count was made in the "battlement" manner. In each case 200 cells were counted on each of two slides from the same blood. The numbers of the types of leucocytes were then expressed as a percentage. (See Table II.) During this work many blood stains were tried, including Giemsa, Wright, Jenner and May-Grunwald. The most satisfactory for general work was found to be Leishman's stain.

TABLE II

No.	Neutrophils per cent.	Lymphocytes per cent.	Monocytes per cent.	Basophils per cent.	Eosinophils per cent.
1 ...	40	45	4	1	10
2 ...	48	45	2	0	5
3 ...	58	32	1	2	7
4 ...	54	32	5	1	8
5 ...	50	38	4	1	7
6 ...	52	36	6	0	6
7 ...	59	31	4	1	5
8 ...	48	42	5	1	4
9 ...	60	30	6	1	3
10 ...	56	34	4	2	4
11 ...	50	42	2	2	4
12 ...	54	38	4	1	3
13 ...	56	38	3	0	3
14 ...	54	36	5	0	5
15 ...	59	33	6	0	2
16 ...	62	24	5	1	8
17 ...	68	22	4	0	6
18 ...	68	25	4	1	2
19 ...	61	25	9	1	4
20 ...	57	36	4	0	3
21 ...	54	35	4	0	7
22 ...	61	34	3	0	2
23 ...	63	25	7	0	5
24 ...	55	29	5	1	10
25 ...	72	16	7	0	5
	Mean 56.7 ± 6.7	Mean 32.9 ± 7.3	Mean 4.5 ± 1.7	Mean 0.68 ± 0.68	Mean 5.2 ± 2.1

Summary

The results obtained in blood examinations in 25 healthy kittens between the ages of one and six months were as follows:

Red blood corpuscles, 6.9 ± 1.0 millions per c.mm.
White blood corpuscles, 13 ± 3.2 thousands per c.mm.
Hæmoglobin, 10.9 ± 0.9 g. per 100 ml.
Neutrophils, 56.7 per cent. ± 6.7.
Lymphocytes, 32.9 per cent. ± 7.3.
Monocytes, 4.5 per cent. ± 1.7.
Basophils, 0.68 per cent. ± 0.68.
Eosinophils, 5.2 per cent. ± 2.1.
M.C.V., 47.2 cubic microns.
Reticulocytes, 0.15 per cent.
Coagulation time, 2-4 minutes.
Specific gravity, 1054.
Diameter of red cells, 6.0μ ± 0.3.
Packed cell volume, 32.6 per cent. ± 3.2.
Fragility of red cells—
Complete lysis below 0.36 per cent. NaCl.
Partial lysis at 0.4 per cent. NaCl.
(Note.—The sign ± denotes the standard deviation.)

Acknowledgment

I wish to thank Miss Mills, B.V.Sc., M.R.C.V.S., for assistance in collecting many of the samples.

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THE DISTRIBUTION OF MEASLES (CYSTICERCUS BOVIS) IN AFRICAN BOVINE CARCASSES

By Dr. IGNACY MANN and ERIKA MANN

Veterinary Department, Kenya

Introduction

DURING the course of fifteen months' inspection of bovine carcasses at Messrs. Liebig's Factory, Athi River, Kenya Colony, British East Africa, we have examined 92,845 cattle, of which 7,334 or 7.89 per cent. were found to be infected with measles.

The origin of these animals was as follows: 83,850 were Tanganyika cattle from the Singida and Dodoma districts, Lake, Western and Northern provinces; 8,995 were from Uganda and these cattle had a high incidence of measles, namely, 19.07 per cent.

We have also been able—without opposition from the owners—to cut the carcasses to a much greater extent than is normally permissible in abattoirs; after inspection, all meat is used for canning and accordingly is cut into small pieces by power-driven cutters.

One of us has made all the carcass inspections and it has, therefore, been possible to maintain the same method and standard of inspection throughout. It should nevertheless be stated that the actual percentage of infections, and especially of the slight infections, is probably 0.5-1 per cent. higher than recorded, owing to difficulties attendant upon the routine inspection during the first nine months. For example, much of the inspection was done during the night with poor lighting and, before a special inspection room was built, inspection was performed on the single-rail system, under which the Meat Inspector has only one minute for the inspection of each carcass, longer detention stopping the work on the whole line.

Routine Inspection for Measles

Our routine examination for measles consisted in making two deep incisions reaching to the bones in both arms, one long incision through the base of the tongue, thorough inspection of the pluck, especially the heart, and inspection of the surface muscles. Should any measles be found in these places, further additional cuts were made in the filets, muscles of neck and hump and thighs.

During the first three months of our work two incisions were made into the external masticatory muscles, but we found that these muscles were not predilection sites and this practice was discontinued.

As a result of several thousand inspections, we feel that there exists an urgent need for a re-examination of the distribution of *Cysticercus bovis* in infected carcasses, with the object of determining whether the existing and accepted regulations concerning the place and number of incisions do in fact ensure a sufficient check on whether a carcass should be passed for human consumption or condemned. At the same time, the following questions have been investigated:—

(a) What percentage of measles, out of the total number of measles infesting a carcass, is shown by the accepted incisions?

(b) How many live measles may be found in a whole carcass passed as "slightly infected" by the accepted incisions?

(c) Is it possible to find dead and living measles in the same carcass?

(d) Can infections of different age occur simultaneously in the same carcass?

(e) Which are the best sites to be inspected so as to obtain a true picture of the infection?

The present study is an attempt to answer these questions and also as a logical outcome of our findings we have suggested a different "cut" which we believe will prove more reliable as a routine inspection measure.

Method of Work

The ideal method of approach to this problem is to dissect complete carcasses minutely, to count the measles found in every organ, muscle or muscle group, and after a thorough miscroscopical examination to pass the measles through a viability test.

(a) *Dissection of carcasses:* The term "carcass" as used in the present study refers to a slaughtered animal, skinned, eviscerated and with tarsus and carpus removed. For the sake of brevity the muscles and organs have been arranged into the following regional groups:

> face and external masticatory, internal masticatory, hyoid, tongue, neck and hump, thorax, diaphragm, shoulder girdles, shoulders, arms, forearms, back and loins, abdominal muscles, sublumbar muscles, right and left hindlegs, tail, trachea and œsophagus, heart, liver, lungs, kidneys, brain, eyes, spinal cord and bones.

(b) *Viability test:* All measles found, with the exception of those definitely calcified, have been passed through a viability test after being carefully removed from their connective tissue capsules. As Ransom (1911), Monnig (1936), Perroncito (1876), Hertwig (1891), Porter (1923) and others each recommend different methods of testing the viability of measles, we have tried to find a standard method as near as possible to the test devised by Iwanizky and Keller (1935). Iwanizky, according to Keller (1935), removed measles out of the muscles but not from their connective tissue capsules, and sewed them into small silk bags. The bags were smeared with butter and swallowed by volunteers. Some 20 to 24 hours later the silk bags were recovered from their stools and the contents of the bags were examined to see whether the dead measles had been digested and absorbed or if the live cysticerci had evaginated and developed their scolices. In 1935 Keller improved Iwanizky's method in that he placed the measles to be tested into small celluloid tubes sewn in silk bags. In this way scolices evaginated or liberated in the small intestine were protected from pressure in the large intestine; he further found that the best results were obtained after removing the cysticerci from their connective tissue capsules.

We found it unnecessary to search for a medium suitable for the evagination of fully-developed measles, the medium we needed being for measles at different stages of degeneration. This should be very stimulating as measles which have reached a certain maturity are difficult to evaginate in a simple medium such as saline with ox bile.

It is not necessary to describe in detail all our experiments with such media as distilled water, saline, urine, dropsical fluids, acid hydrochloric + pepsin + bile solution, bile in different concentrations, blood, hæmolised serum, unhæmolised serum pure and mixed with bile in different concentrations. We did, however, find that for viability tests in vitro, the ***best results were obtained with unhæmolised ox serum to which 10 per cent. of ox bile was added.*** We have also found that serum derived from animals infested with measles did not restrain the evagination of this parasite in vitro.

This mixture of unhæmolised ox serum + 10 per cent. ox bile has often

allowed the measles to evaginate, although these had previously been tested for hours in other media and been considered dead. The growth rate is greatly increased in this medium and we have obtained specimens one inch long after about two weeks; measles of the same batch, kept in 50 per cent. bile saline or in pure ox bile, have grown only to half this size. In ox bile + saline, the measles die within three days, the head detaching itself from the neck. We are unable to explain the reason of this phenomenon, but it does not occur in clear serum + bile.

When testing the viability of measles we have followed this technique:

(1) All measles were carefully removed from their connective tissue capsules.
(2) They were placed in warmed (40 deg. C.) Petri dishes containing unhæmolised ox serum + 10 per cent. ox bile.
(3) The evaginated measles were counted at five-minute intervals, later at hourly periods.

We have also recorded the speed of evagination and found that young measles always evaginate within the first 5-10 minutes, whereas measles with marked signs of degeneration may require up to 36 hours.

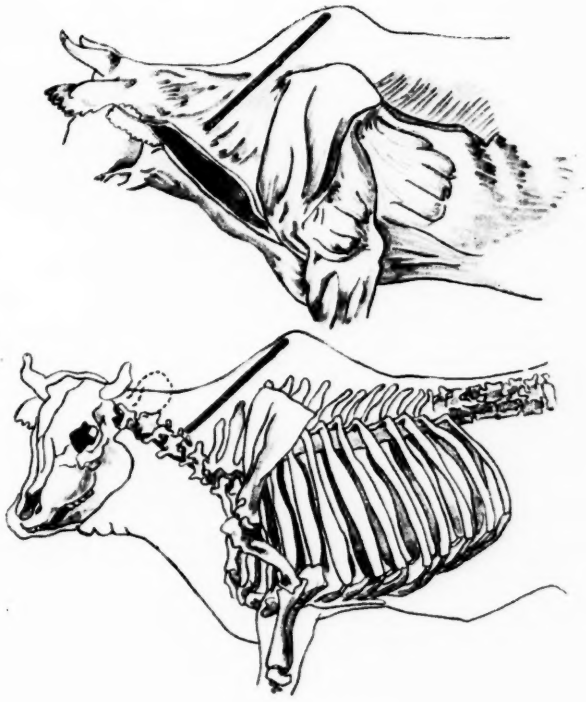
Measles have been considered dead only when no evagination took place after 48 hours. After this time, the total percentage of evaginated measles was calculated, a hundred measles from different parts of the infested carcass having been used whenever possible.

It must be mentioned that some measles, although not showing any evidence of degeneration and although their scolices be well visible, do not evaginate. At first we thought that these might have been damaged during removal from their host, but eventually we have been satisfied that it is impossible to obtain a 100 per cent. evagination, even with the greatest care, because there probably is a small percentage of recently dead measles to be found in every carcass. These conclusions are not only founded on the examination of measles in the fifteen carcasses recorded below, but after considering and testing thousands of measles, a small percentage of which invariably did not evaginate for some, up to now, unknown reason.

(c) *Thermomicroscopical test for viability:* In order to study the structure and motility of the evaginated measles we used the thermomicroscopical viability test. We were careful not to be misled by pseudo-viable movements as reported by Porter (1923) who found that cysticerci which had been kept in boiling water for one hour showed motility after cooling and subsequent reheating on a warm stage.

She found the same type of movement on warm stages with certain materials such as indiarubber, chamois leather, catgut and silk, and does not, therefore, consider that a test of viability based on the motility of cysticerci when exposed to heat stimuli is conclusive.

In the absence of a Nuttal thermomicroscope we worked in the large incubator room used for the test incubation of corned beef, where the measles and their observer could be kept at 38-40 deg. C. This proved ideal as the measles taken from their evagination medicum could be placed on a slide with a few drops of



SITE OF THE PROPOSED CUT.

GROUP I
GROUP II
GROUP III
FACE & ENTIRE SKIN SURFACE
INTERNAL MASTICATORY
TONGUE
ESOPHAGUS
NECK & WAIST
HEART
THORAX
DIAPHRAGM
BACK & LOINS
ABDOMINAL MUSCLES
SHOULDER MUSCLES
LEFT SHOULDER GIRDLE
LEFT PHOULDER
LEFT ARM
LEFT FORE ARM
LEFT HAND & LEG
RIGHT SHOULDER GIRDLE
RIGHT PHOULDER
RIGHT ARM
RIGHT FORE ARM
RIGHT HAND & LEG
TAIL
TRACHEA
LUNGS
LIVER
KIDNEYS

medium and be examined microscopically under optimum thermal conditions. By these means we have had proof that the measles were alive as they had evaginated, and the thermomicroscopical test was further confirmation of their viability.

Selection of Carcasses

To study the distribution and number of measles fifteen carcasses were chosen and dissected. These carcasses were divided into three groups, each containing five representative animals.

First Group: This group consisted of five animals which on routine examination revealed not more than two measles and, therefore, might have been passed for human consumption.

Carcass No.	Sex	Age Years	Weight lb.	Origin	Measles found by arm cuts
1	Cow	6	450	Lake & West. Prov. Tanganyika	1
2	Ox	12	380	Ditto	1 calc.
3	Bull	1½	350	Ditto	1
4	Ox	12	400	Northern Province Tanganyika	1
5	Ox	2½	450	Dodoma District Tanganyika	2

Second Group: This consisted of five carcasses showing more than two but less than six measles on routine examination.

Carcass No.	Sex	Age Years	Weight lb.	Origin	Measles found by arm cuts
6	Ox	3½	400	Singida District Tanganyika	4
7	Steer	6	450	Dodoma District Tanganyika	3
8	Cow	5	420	Lake & Western Prov. Tanganyika	4
9	Cow	1½	380	Ditto	5
10	Bull	3½	400	Dodoma District Tanganyika	4

Third Group: On routine examination carcasses of this group revealed more than six measles.

Carcass No.	Sex	Age Years	Weight lb.	Origin	Measles found by arm cuts
11	Bull	13	500	Dodoma District Tanganyika	15
12	Ox	6	500	Lake & Western Prov. Tanganyika	34
13	Cow	12	450	Singida District Tanganyika	74
14	Bull	4	500	Ditto	18
15	Bull	8	600	Lake & Western Prov. Tanganyika	19

We have not selected exceptionally heavily infested carcasses for the last group, as our aim was not to find a record number of measles. During our work we have found many carcasses in which hundreds of bladders protruded on the cut surface of the accepted incisions. One carcass, for instance, had 4,864 measles in the forequarters and 916 in the heart alone; another one contained 3,263 measles in the neck and hump.

Results of dissection: The results are appended in the form of a table for all three groups of carcasses:

TABLE

Description of Measles Found on Dissection

Carcass No. 1: Measles strongly attached to host, bladder content pink or even red, the scolex being discernible as a white point. 89 per cent. evaginated rather slowly with quick movements of suckers which were easily visible under microscope. Unevaginated measles, when expressed from the receptacle, showed closed suckers resembling horizontal or vertical lines.

Carcass No. 2: Only degenerated measles were found, the hardest cysts being in liver, lungs and heart. Two measles found in the right forearm and one in the left shoulder, were very soft, containing only a greasy greyish-green substance. The connective tissue capsule and the measle proper formed one hard body of about 2 cm. in length. Calcification had probably started in the internal organs, reaching the measles in the forequarters later.

Carcass No. 3: Young measles, 6-8 weeks old. No full evagination was obtained although many measles pushed their head out of the hilus.

Carcass No. 4: Live, caseified and calcified measles were all found, distributed thus: 6 calcified, 2 caseified and 2 live in the heart; 1 calcified and 1 live in the lungs; 3 caseified in the liver; 2 calcified and 1 live in the diaphragm. The live measles had very strong and hard connective tissue membranes, were strongly attached to the caudal vesicle, the bladder fluid being changed into a pseudo-purulent mass. These measles we considered as at the end of their life. Out of the remaining 202 measles found, 66 evaginated. They had very strong scolices, fairly movable suckers and large quantities of calcarous corpuscles, especially between the folds of the neck.

Carcass No. 5: Fully-developed measles, 93 per cent. of which evaginated during the first ten minutes.

Carcass No. 6: Adult measles of which 87 per cent. evaginated within 15 minutes.

Carcass No. 7: Calcified and caseified measles of unusual size (2 cm. by 1 cm.). The contents were greasy, greenish or greyish-green with abundant calcarous detritus. Out of the 847 measles found, 12 were still alive, namely: 2 in the œsophagus, 6 in the neck and 4 in the sublumbar muscles. These 12 measles evaginated within 36 hours. Thermomicroscopical test shows movements of scolex and suckers which had very strong muscular layers surrounding them.

Carcass No. 8: Large measles containing a thick, turbid fluid of reddish-brown colour. 93 per cent. evaginated within 12 hours.

Carcass No. 9: Bladder contents were reddish. 94 per cent. evaginated after 24 hours.

Carcass No. 10: Very young measles, estimated as 3-5 weeks old, appearing as round cysts of pin-head size, no receptaculum or scolex being visible.

Carcass No. 11: Two types of measles were found: (a) ripe, fully-developed measles, with spherical or elliptical bladders which were very elastic and had

transparent membranes and easily discernible scolices. (b) 26 very old, completely calcified, stone-like measles. These were distributed as follows: 1 in neck, 2 in diaphragm, 4 in the arms, 1 in back and loins, 2 in the left thigh, 1 in the right thigh, 7 in the heart, and 8 in the lungs. They are certainly from an older but lighter infection. From the 919 measles of groups (a), 89 per cent. evaginated within 30 minutes.

Carcass No. 12: Young measles, 84 per cent. of which evaginated within ten minutes.

Carcass No. 13: Strongly hæmorrhagic measles, 91 per cent. of which evaginated within five minutes, showing lively movements of neck, head and suckers.

Carcass No. 14: All the measles were apparently dead and consisted of very strong, hard, connective tissue membrane, firmly attached to the measles proper and forming a remarkably long body very resistant to pressure. On dissecting them, however, they showed a scolex embedded in a soft medium. Two of the measles found in the heart, 2 in the lungs, 3 in the liver, and 2 in the tongue contained only a greenish-greyish mass. None evaginated. Of the remainder, 36 per cent. evaginated after 24 hours.

Carcass No. 15: Measles from this animal were rather small, containing almost chocolate-brown fluid with hæmorrhagic spots. 86 per cent. evaginated slowly. The measles had very short, thick necks, heavily folded and with large calcarous corpuscles.

The hystograph shows clearly the close relationship between the distribution of measles in the various muscle groups, whether the animals were lightly, moderately or heavily infested, the chief predilection sites for cysticerci being obviously the thighs, the back and loins and the neck and hump, followed by the shoulders and heart.

The most striking is the percentage of measles found in the masticatory muscles. Ostertag (1933) and Hutyra and Marek (1916) considered this muscle group as highly indicative. Veenstra (Holland, 1925), Krupski (Switzerland, 1917), Funk (Germany, 1935) and Mohler (1933) found the masticatory muscles the most common site of infection and therefore of first importance to the Meat Inspector. Our findings, 0.78 per cent. of the total measles found, relegate this muscle group to the 21st place as compared with Viljoen (13.28 per cent.), who puts the masticatories in the third place of importance.

As Viljoen's work (1937) has also been done on African cattle, it is worth while comparing it with our findings. He found only 1.40 per cent. measles in the heart, against our 5.35 per cent. Our average for neck and hump was 10.17 per cent., his 6.54 per cent. In shoulders and elbows, Viljoen (1937) found 28.10 per cent., whereas we found 13.80 per cent. That means that the accepted incisions in both forearms are, in East Africa, 50 per cent. less indicative than in South Africa. Unfortunately, Viljoen does not give the origin of the 25 carcasses which

he dissected at Bloemfontein; we do not know if they were European, African or improved stock. As his findings are very similar to those of European and American workers (Veenstra, 1925, Mohler, 1933, Krupski, 1917, and Funk, 1935), it can be presumed that either his carcasses were of Eureopean origin or that by improving the native cattle with European stock, the predilection sites of Cysticercus bovis have been changed. In any case his findings are not indicative for East African cattle.

Discussion

In this discussion we shall refer not only to the fifteen selected carcasses, but also to our previous experience. What was surprising to us was the similarity in the distribution of measles in certain groups of muscles in all three groups of carcasses.

We shall now answer the questions which presented themselves to us during routine inspections:

(a) *What percentage of measles, out of the total number infesting a carcass, is shown by the usual forearm incisions?*

First Group:

Total number of measles found by the accepted incisions 6

Number of measles found on complete dissection 1001

The accepted incisions have thus only revealed 0.59 per cent. of the measles present in the carcasses, that is *167 unseen measles to each one seen.*

Second Group:

Total number of measles found by the accepted incisions 20

Number of measles found on complete dissection 2558

Only 0.56 per cent. out of the total number of measles infesting these carcasses were found by the accepted incisions: that is *178 unseen measles to each one seen.*

As carcasses of the first and second group may, depending on local regulations, be passed for human consumption (because they revealed less than six cysts per carcass by the accepted incisions), they have been grouped together:

Total number of measles found by accepted incisions 26

Number of measles found on complete dissection 4559

That is 0.57 per cent. of the total number of cysts infesting ten carcasses, *or 175 unseen measles to each one seen.*

Third Group:

From the Meat Inspector's viewpoint, this group is unimportant, as the carcass would in any case be condemned as unfit for human consumption. However, the figures for this group are:

Total number of measles found by the accepted incisions 160

Number of measles found on complete dissection 7380

Only 2.16 per cent. out of the total number of measles infesting these carcasses were seen by the accepted incisions, that means *46 measles unseen for every one seen.*

It is obvious from the above figures that the percentage of measles found by the usual incisions increases with the degree of infestation, but, at best, this is a very small proportion of the total number of measles present in a beast.

(b) *How many live measles may be found in a carcass passed as "slightly infested" by the accepted incisions?*

First Group:

Total number of measles found	1001
Number of measles considered dead (32 calcified, 183 not evaginated) and 233 young, undeveloped cysts	448
Number of live measles	553

55.24 per cent. of all measles recovered, evaginated: that is an average of 110 measles per carcass.

Second Group:

Total number of measles found	3558
Number of measles considered dead (835 calcified, 169 unevaginated) and 433 undeveloped measles	1437
Number of live measles	2121

59.61 per cent. of the total number of measles recovered, evaginated, or 424 per carcass.

As the first and second groups might both be passed as fit for human consumption, we joined them, obtaining the following figures:

Total number of measles found	4559
Number of measles considered dead and undeveloped ones	1885
Total number of live measles	2674

This gives 56.65 per cent. viable measles and an average of 267 live measles per carcass.

Third Group:

Total number of measles found	7380
Number of measles considered dead (35 calcified, 841 not evaginated)	876
Number of live measles	6504

88.13 per cent. of all measles found evaginated, and the average number of live measles is 1,300 per carcass.

(c) *Is it possible to find dead and alive measles in the same carcass?*

An answer to this question is very important as certain German authorities like Hock (1934) advise one evaluation for calcified and caseified cysts and another for live measles. As the process of decay always starts at the outer surface of the measle, spreading centripetally, it is possible that a carcass with apparently calcified

cysts may be passed. It is difficult—if not impossible—for the average Meat Inspector to test the measles found for viability, and even then the cysts found by the usually recommended incisions may not be alive (*vide* carcass No. 2 where calcification started in the left forearm and the right shoulder, or carcass No. 7 where 12 live measles were found in the œsophagus, neck and hump in the sub-lumbar muscles). We consider young measles with undeveloped scolices or suckers as less dangerous than measles with a stone-like appearance, which would be considered dead by an Inspector, as the latter type can—and under certain conditions does—evaginate.

Is there any rule which controls the death of the measles in various sites? We are of the opinion that cysticerci living in organs such as the lungs, liver and heart, die first and that those in the stripped muscles remain alive longer. We also believe that the process of death, as noted by Hutyra and Marek (1916), Ostertag (1913) and Penfold, is not as simple as it has been described, but it is quite possible that these descriptions may have been based on visual examination only and not on the results of evagination tests. The authors mentioned accept the view that a fully-grown cyst must—after a certain time—first caseify and then calicfy. If this were true, and assuming the life of a cysticercus to be about 22 months, the number of carcasses with totally calcified measles should be much higher than it actually is, especially in African cattle. Actual observations show, however, that this is not so and that the proportion is of one carcass with calcified measles to 30-35 carcasses with live cysts. This can either be explained by the fact that measles live much longer than it has in the past been assumed, or else by the conception that measles are reabsorbed by their host after death and do not necessarily have to calcify. We have had proof that sudden death of cysticerci can occur in a carcass. We have found fully-developed cysts in a heavily infested carcass, which were elastic, with visible scolices and which we considered on visual examination to be viable. Yet not one of them developed in the evagination medium. What had caused the death of these measles? Was it a sudden reaction of their host's organism or some disease or a shock caused by a new infection? We have noted that tuberculosis, especially when advanced with calcified lesions in glands or organs, hastens the calcification of measles. Jaundice, on the other hand, often causes an evagination *inside the bladder* followed by hæmorrhagic infiltration of the bladder fluid with death of the measles. Jaundice due to East Coast Fever causes death of all measles within 7-10 days.

(d) *Can infections of different age occur simultaneously in the same carcass?*

A typical case is carcass No. 11, which answers this question. This animal harboured 26 calcified measles as well as 919 live cysts which showed no signs of degeneration. As none of these 919 cysts show any evidence of coagulation or caseation, we must accept the fact that this carcass was infected on two separate occasions. We have often found similar cases, such as an old, slight infection with stone-like measles superimposed by a more recent one. In almost 5,000 infected carcasses examined, we have never seen an infestation by two types of measles, that is, by young and old live parasites, simultaneously. The reason for this may be that the first infection, for as long as the measles are not completely degenerated, produce immunity against a fresh infestation. The proportion between old and new infections would be well worth studying and a number of carcasses of this type ought to be dissected.

(e) *Which are the best sites to be inspected so as to obtain a true picture of the infection?*

The incisions in the external and internal masticatory muscles, so praised and advocated by Ostertag (1913) and others, prove—in our investigations—to be unreliable, as these incisions revealed fewer parasites than the liver, which is often regarded as measle-free. To summarise, we give below the order of frequency in which measles occur in the different muscle groups:

Right thigh and leg	12.85%	Abdominal muscles	2.27%
Left thigh and leg	12.06%	Right forearm	2.12%
Back and loins	10.29%	Left forearm	1.57%
Neck and hump	10.17%	Liver	1.43%
Sublumbar muscles	8.84%	Lungs	1.43%
Left shoulder	5.72%	Hyoid	1.11%
Heart	5.35%	Diaphragm	1.06%
Right shoulder	4.39%	Face and ext. masticatory ...	0.78%
Left shoulder girdle ...	3.00%	Internal masticatory ...	0.72%
Tongue	3.00%	Tail	0.34%
Left arm	2.93%	Œsophagus	0.32%
Thorax	2.82%	Trachea	0.25%
Right arm	2.74%	Kidneys	0.09%
Right shoulder girdle ...	2.51%		

It is worthy of note that, while inspecting 55,000 livers, we have often found measles in this organ, even when they were scarce or absent in the accepted cuts. In contradistinction, we have met with only one cyst in 10,000 brains examined and none at all in the eyes, spinal column or bone-marrow.

The best place of incision would, undoubtedly, be the thigh and leg as in these sites infection may reach 13.90 per cent. Unfortunately, such an incision would have to be made on the medial side and would be difficult, the cut having to be made while the carcass was still recumbent on the floor, before being hoisted: after hoisting it would be out of reach.

In African cattle the part of the carcass showing a heavy infestation (10.59 per cent.) in a relatively small amount of muscles is the neck and hump. Viljoen (1937) found that 20 out of the 25 heavily infested South African carcasses had measles in the neck and hump: our findings show a much more frequent occurrence of cysts in these muscles.

For comparison, 1,000 carcasses taken at random have been examined for measles by both the accepted, usual incisions and by the cut recommended, that is, through neck and hump.

By two incisions in the left arm, out of 1,000 carcasses measles were found in	17
By two incisions in the right arm, measles were found in	14
	31

By doubling the number of incisions, that is, by making four incisions into each arm, measles were found in 51 carcasses. In order to find out whether the

remaining 949 carcasses would show any infestation on further examination, 100 of them taken at random were dissected, with the result that 23 slight additional cases of cysticercus infestation were brought to light.

On the other hand, the cut through the neck and rump (which we recommend), when carried out on the same 1,000 carcasses, revealed infestation in 68 of them, that is, 17 more cases were detected by it than by the accepted cuts into the forearms. Out of the remaining 932 carcasses found free of infection by the cut through the neck and hump muscles, 100 were taken at random and dissected: only four more cases of cysticercosis (slight) were found.

Based on these findings, we have come to the conclusion that if some group of muscles has to be considered as a predilection site of *Cysticercus bovis*, this is the neck and hump and this should, therefore, be incised. It has the advantage of a single cut instead of several and revealed the presence of measles in 1.7 per cent. more carcasses than the accepted incisions: only 4 per cent. more cases were left undetected by this cut as compared with the 23 per cent. of cases not found by the accepted incisions into the forearms. It exposes a large cut surface and the incision opens by itself owing to the weight of the forepart of the cut neck muscles. The drawing below shows the exact place of the recommended incision: it should start in the first third of the forepart of the hump, passing obliquely through the whole muscle group until it reaches the processa spinosa of the first thoracic vertebra and the processa spinosa of the seventh cervical vertebra. We have applied this incision innumerable times, have always obtained good results, and can recommend it.

Acknowledgment

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DISTRIBUTION OF MEASLES IN 15 BOVINE CARCASSES.

Site.	GROUP 1. Number of measles found in Carcass No. 1	2	3	4	5	% of total measles.	GROUP 2. Number of measles found in Carcass No. 6	7	8	9	10	% of total measles.	GROUP 3. Number of measles found in Carcass No. 11	12	13	14	15	% of total measles.
Face and external Mastic ...	—	—	—	2	3	0.49%	3	5	8	22	5	1.20%	2	24	14	—	9	0.65%
Internal Masticatory	—	1	4	3	1	0.89%	—	16	3	12	1	0.89%	12	5	7	1	4	0.40%
Tongue	5	1	12	3	15	3.59%	4	33	21	34	8	2.81%	24	63	72	7	28	2.60%
Œsophagus	1	—	1	—	2	0.40%	—	6	1	—	4	0.30%	8	5	8	—	—	0.28%
Hyoid	1	1	2	3	3	0.99%	2	4	11	9	7	0.89%	3	26	46	8	24	1.46%
Neck and Hump	7	2	21	32	44	10.59%	15	105	81	115	71	10.87%	84	151	291	31	111	9.05%
Heart	33	1	15	10	1	6.00%	2	118	17	102	4	6.82%	70	52	83	2	25	3.25%
Thorax	3	—	—	4	19	2.59%	2	36	8	36	11	2.61%	41	40	81	6	73	3.27%
Diaphragm	4	—	4	3	1	1.19%	3	4	12	23	3	1.26%	11	18	22	2	1	0.73%
Back and Loins	12	—	22	33	37	10.39%	8	43	186	79	21	9.47%	87	180	381	30	136	11.03%
Abdominal muscles	5	—	6	1	8	1.99%	3	6	33	27	11	2.24%	30	11	92	4	53	2.57%
Sublumbar muscles	8	—	14	11	30	6.10%	18	56	87	73	28	7.36%	186	143	421	36	164	12.88%
Left shoulder girdle	4	—	11	9	9	3.30%	5	25	22	28	9	2.50%	19	65	106	7	40	3.20%
,, shoulder	8	—	9	13	23	5.30%	9	38	56	55	40	5.68%	36	114	218	12	83	6.20%
,, arm	5	3	3	4	10	2.50%	2	18	14	52	31	3.28%	25	40	89	18	55	3.03%
,, forearm	—	1	4	1	6	1.20%	1	13	13	19	5	1.43%	13	45	46	8	42	2.08%
,, thigh and leg	35	1	22	13	48	11.89%	18	79	141	137	51	11.97%	103	213	386	43	152	12.16%
Right shoulder girdle	6	—	8	6	5	2.30%	3	31	30	47	7	3.31%	15	39	59	2	26	1.92%
,, shoulder	8	—	6	16	8	3.80%	8	41	30	91	35	5.76%	20	50	96	25	76	3.61%
,, arm	8	—	8	3	5	2.40%	7	23	16	44	20	3.09%	26	19	91	14	51	2.75%
,, forearm	5	—	7	—	13	2.50%	6	19	20	22	3	1.96%	9	29	54	4	45	1.92%
,, thigh and leg	28	—	42	22	47	13.90%	21	88	143	124	46	11.86%	82	221	402	46	131	11.95%
Tail	3	—	—	1	1	0.50%	1	—	3	9	1	0.39%	—	1	6	1	2	0.13%
Brain	—	—	—	—	—	0.00%	—	—	—	—	—	0.00%	—	—	—	—	—	0.00%
Eyes	—	—	—	—	—	0.00%	—	—	—	—	—	0.00%	—	—	—	—	—	0.00%
Trachea	1	1	1	—	1	0.40%	—	7	1	—	—	0.22%	—	2	6	—	2	0.13%
Lungs	8	4	8	2	—	2.20%	—	3	2	5	2	0.33%	30	72	21	2	5	1.77%
Liver	8	2	3	7	2	2.20%	—	25	13	—	8	1.29%	5	12	32	3	9	0.82%
Kidneys	—	—	—	—	—	0.00%	—	5	—	—	1	0.16%	4	2	4	—	—	0.13%
Bones	—	—	—	—	—	0.00%	—	—	—	—	—	0.00%	—	—	—	—	—	0.00%
Spinal Cord	—	—	—	—	—	0.00%	—	—	—	—	—	0.00%	—	—	—	—	—	0.00%
Total	206	18	233	202	342	100.00%	141	847	972	1,165	433	100.00%	945	1,642	3,134	312	1,347	100.00%

COMBATING OF TUBERCULOSIS AMONG CATTLE IN DENMARK

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In a previous paper in this Journal it was mentioned that a strong interest in the combating of tuberculosis among cattle arose among the Danish farmers in the middle 'thirties. Several factors had been contributory to the greater appreciation of the significance of this work, in particular the demonstration of the fact that in a good many cases the occurrence of tuberculosis in man was due to the bovine type of the tubercle bacillus. Also, the circumstance that bovine tuberculosis had been eradicated successfully on several of the smaller Danish islands encouraged the farmers elsewhere to take up this work.

In the above-mentioned paper it also was stated how the planning of this work could be carried out to advantage by the various dairy districts. The area covered by the districts of the individual dairies is such that the manager can easily follow this work in each herd from which milk is received by the dairy; and thus he is able to intervene whenever a farmer does not show the proper understanding of the measures stipulated. Furthermore, the management of the dairies is entitled at a suitable juncture in the control work to interfere and to have adopted additional points in the rules of the dairies, following which a certain time limit is established, within which period all the herds of the milk suppliers have to be rid of tuberculosis; otherwise certain restrictions will be enforced. Finally, it was mentioned that this work received support of various kinds from the public and from a special foundation.

Even though the control of tuberculosis among cattle in the later 'thirties made rapid progress on the larger islands (Zealand, Lolland, Falster and Funen), and even though certain parts of Jutland were able to show a considerable increase in the number of tuberculosis-free herds, it still was evident that if this combating were to be carried through completely within a reasonable number of years and without any risk of being discontinued (*e.g.*, on account of fluctuations of the market), it would be necessary to pass a new law concerning the combating of tuberculosis among cattle. The aim of such a law should not be to break the principle of voluntary compliance, which hitherto has been the main factor in the work carried out, as so far no compulsory directives have been adopted except pasteurisation and the killing of cows affected with tuberculosis of the udder or uterus. The purpose of the law should be rather to create better legal support for this work—as, for instance, the introduction of measures aimed at more effective protection of tuberculosis-free herds and the placing of greater responsibility on owners of tuberculous herds.

After several years' deliberation, a new tuberculosis law was carried through in the summer of 1942. As the various regulations based on this law appear to work altogether satisfactorily, an account will be given of the more important of these regulations, as presumably they will be of interest to the readers of this Journal.

These regulations may suitably be divided into three main groups.

The first of these groups comprises measures to prevent spreading of the infection—especially the elimination of highly infected animals.

While the killing of cows affected with tuberculosis of the udder or uterus became compulsory as long ago as 1898 and 1928 respectively, the Act of 1942 gives authority for the slaughter of cows affected with other forms of open tuberculosis. This applies, for instance, to animals with pulmonary tuberculosis, if they are found among the cows from which milk is put on the market. Further, it is possible to trace the mothers of calves which, on slaughtering, were found to be suffering from congenital tuberculosis—cows which previous experiences have proved to be exceedingly difficult to trace down. In order to obviate possible mistakes in such animals, the diagnosis has to be verified by microscopic examination of the secretion from the cow concerned. If such a cow is found to belong to a tuberculosis-free herd, she is not slaughtered until tests with both bovine and avian tuberculins are carried out on the whole herd in order to demonstrate whether or not avian infection is present.

In the case of herds in which much tuberculosis is present, the Act authorises that in addition to the slaughter of the infected animals, no sale of these cattle except for slaughter may take place; directions are also given concerning the use of the milk from such herds.

Milk from cows with, or suspected of, advanced tuberculosis must not be used for human food or for the preparation of articles of food, and only after boiling may it be used as animal feed. (Milk from cows with udder tuberculosis is to be destroyed in every instance.)

Various restrictions apply to cattle with, or suspected of, advanced tuberculosis. Thus, such cattle are not allowed access to markets or common pastures or other places where cattle are gathered, and they are allowed to be sold only for slaughtering. Furthermore, such cattle must not graze nor are they permitted to be kept anywhere outside the buildings of the farm.

Concerning such cattle which are not from tuberculosis-free herds, the Act establishes that it is the duty of the owner to ensure that cattle belonging to other people are not exposed to the infection. When the owner of a non-tuberculosis-free herd grazes his cattle he must see that by effective fencing or tethering his animals are kept from getting nearer the tuberculosis-free neighbouring stocks than 2.5 metres from the boundary. Even though the owner of a tuberculous (or non-tuberculin-tested) herd in conjunction with his neighbour has already put up a fence between the two farms, he may, in keeping with the Tuberculosis Act, be forced, at his own expense, to erect another fence at a distance of 2.5 metres from the boundary of his neighbour's farm: this may mean a heavy expense. Furthermore, animals belonging to herds such as those referred to are not allowed access to small watering-places used for the watering of tuberculosis-free animals; they are allowed access to larger watering-places only on certain conditions.

Among other important regulations, mention is to be made of the instructions concerning the cleaning and disinfection of wagons used for commercial transport of animals. It is the duty of the owner of the wagon to clean and disinfect it if the hirer states—or if it is evident in some other way—that it involves the transport of tuberculosis-free animals—as, for instance, in cases where the hirer has given

no information about the matter, while the animal is to be transported from a market for tuberculosis-free cattle.

In order to prevent the spreading of infection by the personnel who care for the cattle or milk the cows, or possibly to find the source of a new infection, the Act contains a clause to the effect that if the herd is, or hitherto has been, free from tuberculosis, the owner is entitled to demand that any farm-hand be examined by a physician for the presence of infectious tuberculosis. If the farm-hand refuses to submit to this examination, the owner is entitled to discharge him without any notice. During the discussion of the law in parliament, a clause was inserted to the effect that owners of non-tuberculosis-free herds are obliged to inform the personnel used for the care and milking of this fact.

Since 1898 pasteurisation has been compulsory in Denmark of all cream and milk from which butter is made and from all skimmed milk that is not used for the manufacture of cheese. By the Act of 1942 this compulsory pasteurisation was extended also to include the whey, as various observations has shown that the feeding of whey now and then gave rise to the spreading of the infection. On account of the shortage of fuel, however, this regulation concerning the heating of the whey has not yet been enforced.

Finally, in this group of measures another regulation, aimed at the protection of the herds against infection from tuberculous poultry, is to be mentioned. Among other things, it says that if the cattle, swine and fowls on a farm are free from tuberculosis or are being rid of tuberculosis, the poultry on the neighbouring farm has to be penned in safely unless it can be proved that the poultry there, too, are free from tuberculosis.

The next main group of regulations comprises a number of important measures concerning the dealing in tuberculosis-free animals.

In the 'thirties, during the great demand for tuberculosis-free animals to replace eliminated reactors, the lack of regulations for the sale of tuberculosis-free animals was felt keenly. The Act of 1942 gave more assurance in this field as it forbade the seller to employ such terms as "tuberculosis-free," "reaction-free," "clean," etc., unless the animals had belonged to a tuberculosis-free herd up until 20 days, at the most, before the sale or a tuberculin test, performed on the animal within the last 20 days, had turned out negative. If the buyer requests a certificate to the effect that the animal belongs to a tuberculosis-free herd, or a certificate about a tuberculin test performed on the animal, the seller is allowed only to provide a certificate made out by a veterinary surgeon. Quite definite formulæ are to be employed in these certificates, which are printed on paper of a certain colour, and no other forms are to be used for this purpose.

These certificates are not to be used over 20 days after they are made out, and they lose their validity at once if the animals concerned are not protected against tuberculous infection.

Even though the transfer of animals from the herd of the seller to that of the buyer has to be looked upon as the most expedient procedure with regard to protection of the animals against infection on their transport, our experiences from the 'thirties have shown that it was not practicable to keep the trade within such narrow borders that markets and dealers' premises as intermediate stopping places

could be avoided. The Act therefore has regulations for the establishment of markets for tuberculosis-free animals and for the approval of dealers' premises from which tuberculosis-free animals are to be sold. It is stipulated precisely which certificates are to accompany the animals which are presented for sale in such places, and how the cleaning and disinfection of the market place, premises and transport wagons have to be carried out. Provided that all these regulations are complied with, the animals may be presented for sale in these places without the accompanying certificates being invalidated.

Furthermore, the law decrees that before 1950 all markets for cattle for slaughter must have been divided thoroughly into two parts: for tuberculosis-free cattle and for other cattle. This aims to make it possible for butchers to purchase their heads of cattle without running any risk of financial loss from condemnation of the meat on account of tuberculosis.

Even now it may safely be predicted that such a separation of the cattle will hardly be of any practical significance, and that in the market the conditions of the law will be met with in this way, that only animals from tuberculosis-free herds are admitted to the market: the animals have to be accompanied by a certificate concerning this aspect. After this, the tuberculous animals from the district of the market will have to be delivered directly to a slaughter-house.

The third main group of regulations deals chiefly with measures for the combating of tuberculosis based on tuberculin tests of the herds.

Among these regulations, the first to be mentioned is the order to the veterinary surgeon that it is his duty to follow the directions issued by the Ministry of Agriculture for the performance of tuberculin tests, and to report the result of every test to the Veterinary Directorate. With a view to uniformity of the data on the performance of the test and the reactions of the herd to the test, the reports have to be made out on special forms furnished by the Veterinary Directorate.

Mention is also to be made of the aid offered by the Government in the performance of tuberculin tests. This aid is given partly to the individual owner in the form of full payment for the service of the veterinary surgeon in the performance of the tuberculin test as well as free supply of tuberculin, and partly in the form of grants for collective tests in dairy districts. The aid is given only for tuberculin tests in infected herds.

The free tuberculin test is granted to the owner of a herd only on this condition, that within two weeks after the performance of the test he either sells all the reacting animals or isolates them in the manner ordered by the regulations. His obligations as to isolation of the reactors, purchase of animals, etc., are in force for two years after the performance of the test, and the State subsidy is given once a year so long as the combating of the infection lasts.

In dairy districts, aid is granted—without any obligation on the part of the dairy—to a single orienting test on all the herds within the district. But aid for subsequent tests on the herds in the dairy district is granted only if the dairy takes part in the combating of the tuberculosis after a plan approved by the Veterinary Directorate (see below), and if this work is progressing in a satisfactory way.

As mentioned in the previous paper, in the middle 'thirties many dairy districts adopted working plans for the combating of tuberculosis among the cattle. As these plans worked out very well, a clause was inserted in the law of 1942, stimulating dairy districts to adopt them. Thus, one clause in the law says that every dairy which prior to April 1, 1943, has not adopted a plan approved by the Veterinary Directorate for the combating of the tuberculosis in the district of this dairy, has to lower the price of milk delivered from non-tuberculosis-free herds by an amount fixed by the Ministry of Agriculture—hitherto ½ Øre (1 Danish Krone is 100 Øre and practically equal to 1s.) per kg. of milk. The amount of money thus subtracted is put in the bank in an account, and it is paid back to the owner of the herd concerned only if his herd becomes tuberculosis-free within three years after the dairy district has obtained 80 per cent. tuberculosis-free herds. If not, this amount of money becomes the property of the dairy.

This clause has greatly stimulated the dairies to adopt their plans for combating of the tuberculosis. As these plans have proved highly effective, one of them—a five-year plan—will be cited below. In view of the different stages of progress in the various dairies in addition to five-year plans, three-year and seven-year plans were also elaborated. Here it is to be mentioned that no efforts have been made on the part of the authorities to encourage the dairies to speed up the combating work: on the contrary, it has been emphasised explicitly that it is better for a dairy to try to adopt a five-year plan and carry it out than to have difficulties in the realisation of a three-year plan, for two years more or less will not play any decisive rôle. The important point is that the work is taken up and carried through systematically.

BYE-LAWS FOR THE COMBATING OF TUBERCULOSIS AMONG CATTLE WITHIN THE DAIRY DISTRICTS.

A. *Rules for Tuberculin Tests.*

At the direction of the dairy, the tuberculin tests required for a systematic combating of tuberculosis among the cattle are carried out as follows:

The collective tests in the autumn, mentioned under points (a) and (b), are performed in the months of October-December. Intimation of these tests must be at hand not later than October 1. The spring tests, mentioned under point (c), must be completed before the commencement of grazing; they are performed at the order of the district veterinary officer on herds in which the autumn tests revealed the presence of reactors which the owner has undertaken to separate from the healthy animals in keeping with the given directions. The cost of the tuberculin tests are paid by the dairy to the following extent:

(a) In the case of herds which cannot yet be declared tuberculosis-free the dairy pays for one test a year on all the animals which have not previously shown a positive reaction for bovine tuberculosis.

(b) In the case of herds entered in the register of tuberculosis-free herds, the dairy pays for the number of tests required for their remaining in this register.

(c) All members of the co-operative dairy who pledge themselves to carry out and maintain the stipulated separation between reacting and non-reacting animals are entitled at the expense of the dairy to have the non-reactors in their herds tested once more before the grazing time, if the separation of the animals is approved by the district veterinary officer.

B. *Rules for Reduction in the Price of the Milk.*

The dairy adopts the rule that in a five-year period of combating of the tuberculosis the following reducing system will be applied to the price of the milk furnished from herds that are not reaction-free; this reduction in the amount of money paid to the owners of the herds at the end of the fiscal year is retained by the dairy after the following rules:

(a) In the first half-year after adoption of this plan no reduction is made in the price of the milk, this length of time being allowed for the performance of tuberculin tests and for the commencement of the practical measures to be taken in the combating of tuberculosis.

(b) If a member of a co-operative dairy fails within this time limit to have his herd tuberculin-tested, or if he fails within this period to sell or effectively separate the reactors, the following reduction will be made in the price of the milk to be paid to him:

In the rest of the 1st year,	10	Øre	per	100	kg.	milk
In the 2nd „	15	„	„	100	„	„
In the 3rd „	20	„	„	100	„	„
In the 4th „	30	„	„	100	„	„
In the 5th „	40	„	„	100	„	„

(c) Members of the co-operative dairy who, before the end of the first year of this plan, have established adequate separation between their reactors and non-reactors, will be free from the reduction in the milk price during the first two years of the plan if they pledge themselves to maintain this separation until the last reactors are removed from the herd.

After this, the following reductions in the price of the milk apply to such herds:

In the 3rd year	20	Øre	per	100	kg.	milk
In the 4th „	30	„	„	100	„	„
In the 5th „	40	„	„	100	„	„

(d) The members of the dairy who at the end of the fiscal year furnish proof that all the animals of the herd now are tuberculin-negative will be excepted from the reduction in the milk price.

Members of the dairy whose herds previously have been free from reactors and in which bovine reactors may be demonstrated during the combating period will be free from reduction in the milk price if the reactors are removed within one month after the test, and if such members pledge themselves to have the test repeated on the entire herd about three months later, at their own expense.

But members who may fail to remove any possible reactors as mentioned above will be dealt with after the regulations under points (b) and (c).

(e) The amounts of reduction money thus retained by the dairy are deposited in a special account in the bank employed by the dairy. Members who within the number of years stipulated by the plan furnish proof that their herd has been entered in, or notified to entrance in, the register of tuberculosis-free herds, will at once receive the amounts of money retained by the dairy. Other amounts which at the end of the combating period may still be left on this account go to the dairy and are to be used for purposes aimed at the combating of bovine tuberculosis.

For dairy districts with more than 90 per cent. tuberculosis-free herds, the Act includes some particular clauses aimed to promote the combating of the bovine tuberculosis in the remaining infected herds. All these regulations are put into force, however, only at the recommendation of the individual dairy districts. In the following, the more important regulations will be mentioned briefly.

In the first place the Ministry of Agriculture may order a tuberculin test to be performed on any herd not previously tested, together with the marking of all the reactors in the dairy district. It may then order the reactors to be slaughtered; and, in addition to the slaughter value of the animal, the owner is to receive a compensation corresponding to the difference between the slaughter value of the animal and its market value. One-half of this compensation is paid by the State, one-half by the dairy.

As it was to be expected that most dairies would hesitate in carrying through such drastic measures, the law also includes some other clauses imposing compulsion upon the owners of the last reactors. For instance, the Minister of Agriculture can order that the milk from such herds must not be delivered to the dairy before all the other milk has been received and treated, and that the owner has to transport the milk to the dairy himself (without any cost to be paid by the dairy for this transport).

Also, in the above-mentioned compulsory slaughtering of the last reactors the State may grant a small fixed aid for elimination of these animals in such dairy districts if the owners of those reactors voluntarily agree to the arrangements, and if the dairy is willing to assume certain obligations with regard to the regular

performance of tuberculin tests in the following ten years with provision for the removal of possible subsequent reactors from the dairy district immediately after their disclosure by these tests. In order to ensure that this actually takes place, it is the duty of the dairy to adopt regulations dealing with a considerable reduction in the price paid for the milk furnished from reacting herds to the dairy during the ten-year period. Thus, among the dairies belonging to this particular category, several have adopted a reduction in the milk price amounting to about 12 per cent. In this way the dairy protects itself against difficulties in the "cleaning" of herds that possibly might be infected anew within the ten-year period.

Among the regulations falling outside the above-mentioned three groups, only one is to be discussed here. It is a very important one, namely: the regulation about the constitution of the district veterinary system. In this system the country is now divided into 16 districts, for each of which a district veterinary officer is appointed, whose main task is to assist the Veterinary Directorate in the combating of infectious diseases in domestic animals, especially the combating of tuberculosis and contagious abortion.

The establishment of this district veterinary system has made it possible, in collaboration with the agricultural organisation, to carry through far-reaching work of educational and advisory character among the farmers, and to keep in contact with this work all over the country as well as seeing that the prescribed regulations are complied with.

These district veterinary officers are salaried, being paid by the State, and they are not allowed to have any private practice.

After the passing of this law and after the elaboration of the more detailed directions and regulations, the combating of tuberculosis was taken up in full earnest in those parts of the country where formerly it had met only with minor interest. Further, the obligatory report to the Veterinary Directorate of the outcome of all the tuberculin tests has made it possible for the Directorate to have a survey of the work in every dairy district throughout the country and to control the progress of this work. In Denmark, at present, there are about 200,000 herds of cattle. As is evident from the tabular survey worked out in July, 1946 (Table), the Veterinary Directorate now is acquainted with the standing of practically every herd in the country, and 93.9 per cent. of the total herds can now be designated as reaction-free. As a matter of fact, this survey illustrates the advance made from 1937, even though it has to be added that at that time the detailed knowledge of the Veterinary Directorate of these conditions was limited to hardly one-half of the total herds in the country.

Table: Survey of the Progress in the Combating of Bovine Tuberculosis in Denmark during the Period of 1937-1946.

	Islands		Jutland		Entire Denmark	
	Tuberculin-tested herds per cent.	Reaction-free herds per cent.	Tuberculin-tested herds per cent.	Reaction-free herds per cent.	Tuberculin-tested herds per cent.	Reaction-free herds per cent.
1937	49.4	38.1	48.0	19.7	48.5	26.5
1938	67.5	57.1	57.9	27.1	61.3	38.0
1939	76.7	68.4	64.3	32.3	68.8	45.4
1940	87.1	80.8	69.4	39.4	75.8	54.2
1941	92.9	88.5	74.4	46.8	81.0	61.7
1942	96.2	93.6	86.6	58.9	90.0	71.2
1943	98.0	96.6	96.4	71.3	97.0	80.3
1944	99.3	99.1	97.9	79.4	98.4	86.3
1945	100.0	99.9	98.5	86.3	99.0	91.1
1946	100.0	99.9	99.0	90.5	99.3	93.9

As perhaps it may be of some interest to see to what extent the Government has given direct financial aid to the combating of bovine tuberculosis, it will be appropriate, in conclusion, to give a brief survey of this matter.

Concerning the slaughter of cows affected with tuberculosis of the udder or uterus, as well as those suffering from other forms of open tuberculosis, the State pays the owner a compensation calculated from the price paid in the public slaughter-house of Copenhagen for elderly cows of inferior quality. In the last ten years these compensations have amounted on an average to about 110,000 Kroner per year, and for the last fiscal year the total amount was only about 12,000 Kroner.

In the last ten years the expenses connected with the tuberculin tests—entire or partial payment of the expenses for veterinary assistance and gratis tuberculin—has on an average amounted to about 385,000 Kroner, and for the last fiscal year it was only 180,000 Kroner.

In the last ten years the total expenses for compulsory—or voluntary—killing of the last reactors in the dairy districts have averaged about 155,000 Kroner per year. Since 1942 the amount of this expense has been increasing gradually—to about 235,000 Kroner in the last year.

Finally, about 10,000 Kroner have been paid for advisory work (cinematographs, etc.).

As mentioned in the previous paper, besides the aid granted by the State for the combating of bovine tuberculosis, considerable support for the accomplishment of this task has been rendered by a foundation established in the middle 'thirties. In the first years this fund was built up of duties paid on all slaughtered cattle, and later of duties paid on all cattle exported from this country, plus an additional sum paid by the State.

The funds of this foundation are employed chiefly as contributions to the elimination of reactors, and every owner of reactors has been entitled to benefit from this support when he isolated the reactors following the directions given by the Veterinary Directorate, or if he at once got rid of all the reactors. The amounts paid out by this foundation for the combating of bovine tuberculosis have been very high—highest in 1936, when it was nearly 6 million Kroner. Since then, however, the amounts have been decreasing markedly, and in the last fiscal year it was about 350 Kroner.

In late years the law on which the institution of this foundation is based has been dealing not only with supporting measures for the combating of the bovine tuberculosis, but its scope has been extended to cover, in addition, financial support for the combating of contagious abortion in cattle. Gradually, as the combating of bovine tuberculosis has been progressing, the interest in the combating of the contagious abortion has been increasing. So, even now it is evident that within a few years, when the last remnant of bovine tuberculosis has been eradicated, Danish agriculture will be ardently engaged in combating the other widespread chronic infectious disease among the cattle.

THE ACTION OF THE METHYL ESTER OF PENICILLIN G

By J. ZWEIG
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THE advantages of penicillin esters,—being stable over a period of many months, their slow absorption and excretion ratio, and possible oral administration —encouraged informative "in vitro" experiments with the blood plasma of various domestic animals for potential systemic use in the veterinary field.

Hydrolysis of the penicillin esters is attributed to the action of an enzyme, an esterase circulating in the blood plasma (Ungar, 1946). There is a distinct species specifity in the ability to hydrolyse these esters. Methyl ester of penicillin is hydrolysed in mice (Meyer *et. al.* 1943), in guinea-pigs and rats, but not in rabbits and man (Ungar and Muggleton, 1946). Richardson (1945) found that mice were able to hydrolyse penicillin esters completely, but monkeys, dogs and rabbits showed no appreciable plasma level of free penicillin following subcutaneous inoculation.

The methyl ester of penicillin G. (a white crystalline substance), used in these experiments, contained when hydrolysed in 1 mg. 1,500 units of free penicillin.

Blood samples of the horse, ox, sheep, pig and dog were obtained, and coagulation prevented with "Heparin" (1/500,000), the ester dissolved in arachis oil, and then emulsified in distilled water, being diluted down to a final concentration of 2 units (free penicillin when hydrolysed) per ml. of blood plasma. These mixtures were allowed to stand at room temperature for 1 hour and 24 hours respectively, each with three controls: one with guinea-pig plasma, the second with distilled water and the third with sodium salt of penicillin. The assay was carried out on a 30 by 25 cm. rectangular, double-layered agar plate; the agar adjusted to pH 6.4, the upper layer only containing the test inoculum of the "American" Staphylococcus F.D.A. 209. The individual discs of agar were removed by vacuum punching, and filled with equal numbers of drops of the inoculum by means of a standard pipette. The results were read after 18 hours' incubation.

Of all the samples tested, not one showed any signs of free acting penicillin, even after an additional contact of 24 hours, excepting the guinea-pig plasma containing the sample of ester and the sodium salt of penicillin control. Both were equally positive after the first hour of contact.

The original plan of parenteral application of the ester followed by assay of the free penicillin concentration in the blood in the individual species of animals was therefore abandoned.

My thanks are due to Professor T. Dalling, Director, Veterinary Laboratory, Ministry of Agriculture and Fisheries, for facilities to carry out this work; also to Dr. J. Ungar for his information, and to Mr. G. C. Clayton, B.Sc., of Glaxo Laboratories, for the sample of methyl ester of penicillin.

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CLINICAL ARTICLE

INFECTIOUS ENTERITIS IN THE ZOOLOGICAL GARDENS, REGENT'S PARK

By AIDAN COCKBURN, M.D., D.P.H.

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INFECTIOUS ENTERITIS, or cat distemper as it is known in the Zoological Gardens, has been the cause of great mortality among the Felidæ in the Regent's Park menagerie. Since 1929 the following have died of the condition: tigers, 5; leopards, 17; wild cats, 8; lynxes, 2; servals, 2; leopard cats, 4; tiger cats, 7; ocelots, 6; eyra cats, 1; and cheetahs, 4.

All the casualties among the tigers were cubs, no adult being affected; only one doubtful case is recorded among the civet cats and genets; lions are apparently immune.

The onset of the illness is always sudden. The cat is severely ill, vomits a little, refuses food, on rare occasions has diarrhœa, and sometimes has convulsions. Death follows in 2 to 48 hours after the first symptoms have appeared. Quite often an animal apparently healthy the night before is found dead in its cage in the morning. It is difficult making blood counts on these animals, but two cheetahs that were fatal cases gave white cell counts of 10,000 per c.mm. the day before they died. There is no record of any animal recovering from feline infectious enteritis before 1946 except a Serval cat in 1938.

Post mortem.—In all cases there have been intense injection of the duodenum and usually of the adjoining intestine.

All Felidæ in the past year showing signs of infectious enteritis have been treated with penicillin. The quantity given has been 50,000 units per 100 lb. weight every three hours day and night for three days, and thereafter every three hours during the day only until the animal recommenced to eat. The following animals have been successfully treated: 6 leopards, 2 cheetahs and 1 ocelot.

The following have died in spite of treatment:

Two leopards—one was very young, and the other died in two hours after suddenly developing an epileptiform fit and then becoming comatose.

Two wild cats—only a few weeks old.

Two cheetahs—about six months old.

One ocelot—less than six months old.

All the young animals responded to treatment, but died on the fifth or sixth day of illness from exhaustion. It is obvious that immaturity is a potent adverse factor.

The following were found dead in their cages in the morning: 1 lynx and 1 leopard.

The great majority of the Felidæ, with the exception of the lions, civets and genets, must be regarded as highly susceptible to infectious enteritis. They come

from areas where they would have little opportunity of encountering the responsible organism and so developing an immunity, and are transported direct to their quarters under the very strict quarantine regulations.

After the lynx died, its cage was carefully disinfected and left empty, but when a newly arrived ocelot was placed in it 26 days later the cat must have been infected at once. At any rate, it died nine days later. Again the disinfection was carried out and the cage left empty, but by a series of unfortunate mischances a pair of newly arrived leopards were quarantined in it 23 days later. Again on the ninth day one was found dead and the other extremely ill.

None of the other Felidæ in the building showed signs of the disease, and this encouraged the belief that at least the organism was confined to the one den. Therefore, when a leopard became ill in a house in which several other susceptible cats were kept separated by only wire-mesh barriers, the experiment was carried out to see if the infection could be isolated. A rigid " fever hospital " technique was developed, in which only one keeper attended the sick leopard, and that animal only, and he took great care to change his clothing and boots before and after performing his duties. Disinfectant was liberally used, and it can be reasonably claimed that the organism was not carried to the other animals by either the keeper or the various utensils employed in the house. Nor apparently was it carried on the dust or in the air, for the other Felidæ—a leopard, a snow leopard and three cheetahs—remained in the best of health.

A vaccine is in the course of preparation from the spleen of one of the cheetahs that died, and it is proposed to inoculate all the susceptible Felidæ in the Gardens.

It is hoped that with the help of the vaccine, the improved method of isolation, and exhibition of penicillin, that " cat distemper " will cease to be killer No. 1 of the Felidæ in the Zoo.

My thanks are due to Mr. Skerten and the staff of the Sanatorium, and Mr. Alldis and Mr. Grantham of the North Mammal House, for their suggestions and services during the treatment of the sick animals.

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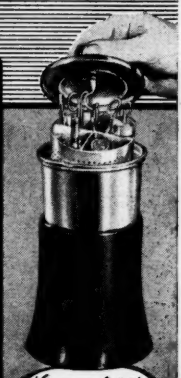

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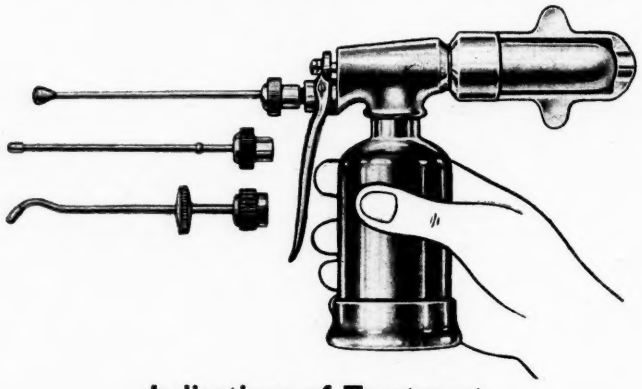

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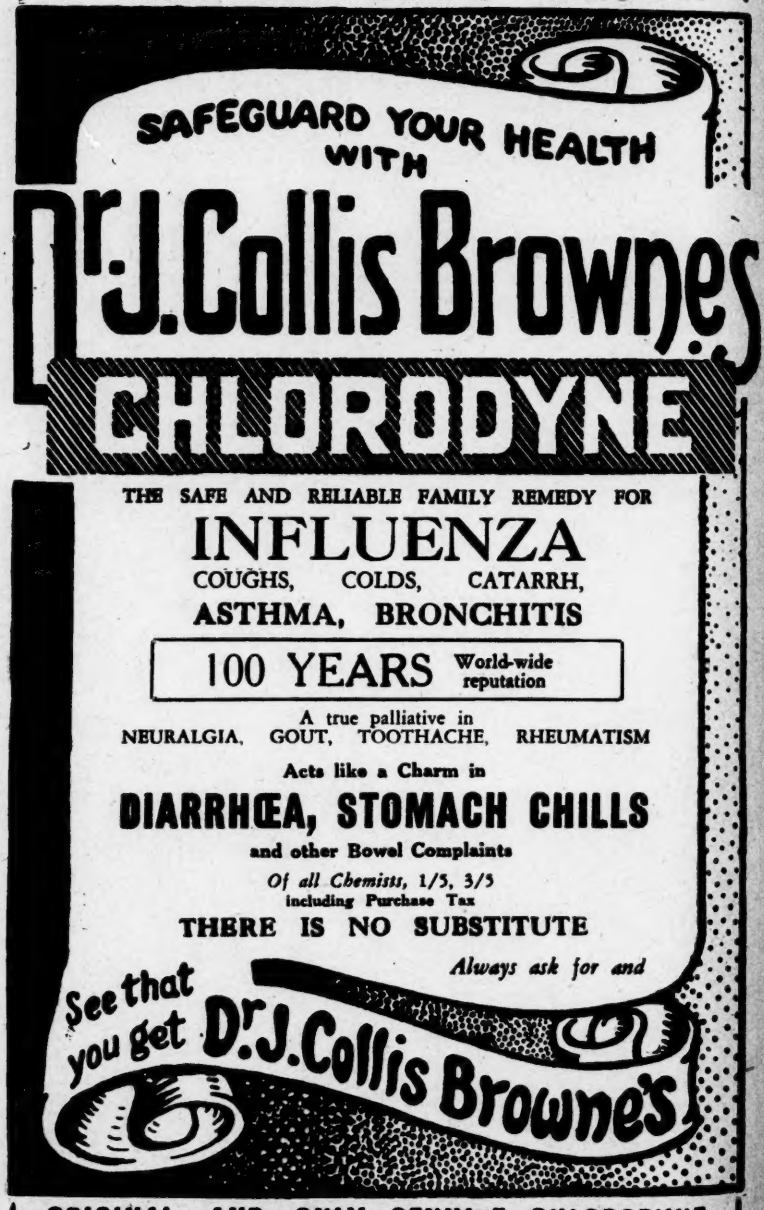

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